

WHAT IS CLAIMED IS:

1. A battery charger for charging a secondary battery, comprising:

5 a battery voltage detector that detects a voltage of the secondary battery and outputs a voltage signal indicative of the voltage of the secondary battery;

10 a battery temperature sensor that detects a temperature of the secondary battery and outputs a temperature signal indicative of the temperature of the secondary battery;

15 a controller that determines an estimated time level from among a plurality of different estimated time levels that indicate how much time is required for the secondary battery to reach a full charge based on the temperature signal and the voltage signal both output when the secondary battery is at a precharge state; and

a display that indicates information regarding the estimated time level based on determination made by the controller.

20 2. The battery charger according to claim 1, further comprising:

25 charging current setter that sets a target charging current to be supplied to the secondary battery and outputs a target current signal indicative of the target charging current set by the charging current setter; and

a charging current controller that controls a charging current flowing in the secondary battery to be in coincidence with the target charging current based on the target current signal,

5 wherein the controller determines a magnitude of the target charging current to be supplied to the secondary battery based on the temperature signal, and outputs a current signal indicative of the magnitude of the target charging current determined by the controller to the
10 charging current setter.

3. The battery charger according to claim 1, wherein the controller changes the magnitude of the target charging current to another magnitude lower by one step than the magnitude determined by the controller after expiration of a
15 predetermined period of time starting from beginning of charging.

4. The battery charger according to claim 1, wherein the secondary battery comprises a plurality of cells connected in series and forms a battery pack.

20 5. The battery charger according to claim 1, wherein the display comprises an LED, the LED including a vessel, a first light emitting diode, and a second light emitting diode, the first light emitting diode and the second light emitting diode emitting lights of a first color and a second
25 color respectively and being sealed in the vessel, wherein

when the estimated time level is a first level, the first light emitting diode is powered to emit the light of the first color; when the estimated time level is a second level, the second light emitting diode is powered to emit the light
5 of the second color; and when the estimated time level is a third level, the first light emitting diode and the second light emitting diode are both powered simultaneously to emit a light of a third color.

6. The battery charger according to claim 5, wherein
10 the controller calculates a battery temperature gradient based on the temperature signal, and wherein when a difference between latest battery temperature gradient and a minimum value of the battery temperature gradient has become a value greater than a first predetermined value, the
15 controller changes the estimated time level to another estimated time level and also changes the color of light emitted from the LED.

7. The battery charger according to claim 5, wherein the controller selects a minimum value of the battery
20 temperature based on the temperature signal, and wherein when a difference between latest battery temperature and the minimum value of the battery temperature has become a value greater than a second predetermined value, the controller changes the estimated time level to another estimated time
25 level and also changes the color of light emitted from the

LED.

8. The battery charger according to claim 5, wherein the controller calculates a minimum value of a battery voltage gradient based on the voltage signal, and wherein
5 when a difference between latest battery voltage gradient and the minimum value of the battery voltage gradient has becomd a value greater than a third predetermined value, the controller changes the estimated time level to another estimated time level and also changes the color of light
10 emitted from the LED.

9. The battery charger according to claim 5, wherein the secondary battery comprises a plurality of cells connected in series, and the controller calculates a voltage per one cell making up the secondary battery based on the
15 voltage signal detected at the precharge state and determines the estimated time level based on the voltage per one cell.

10. The battery charger according to claim 5, wherein the controller determines whether the battery temperature is
20 within a predetermined range based on the temperature signal detected at the precharge state and controls the charge current setter so that a first charging current is supplied to the secondary battery when the battery temperature is within the predetermined range and a second charging current
25 is supplied to the secondary battery when the battery

temperature is out of the predetermined range, the first charging current being larger in current level than the second current.

11. The battery charger according to claim 10, wherein
5 the controller determines whether a predetermined period of time has expired after setting the charging current and changes the estimated time level to another estimated time level and also changes the color of light emitted from the LED.

10 12. A battery charger for charging a secondary battery, comprising:

a battery temperature sensor that detects a temperature of the secondary battery and outputs a temperature signal indicative of the temperature of the
15 secondary battery;

a controller that calculates a temperature gradient within a predetermined time interval based on the temperature signal, determines whether the secondary battery is on the verge of a full charge or the secondary battery
20 has reached a full charge based on the temperature gradient, and further determines an estimated time level from among a plurality of different estimated time levels that indicate how much time is required for the secondary battery to reach a full charge based on whether the secondary battery is on
25 the verge of the full charge or the secondary battery has

reached the full charge; and

a display that indicates information regarding the estimated time level based on determination regarding the estimated time level made by the controller,

5 wherein when the controller determines that the secondary battery is on the verge of the full charge, the controller controls the display to indicate an estimated time level indicative of a minimum time required for the secondary battery to reach the full charge.

10 13. A battery charger for charging a secondary battery, comprising:

a battery temperature sensor that detects a temperature of the secondary battery and outputs a temperature signal indicative of the temperature of the
15 secondary battery;

a controller that calculates a temperature rise of the secondary battery during charging based on the temperature signal, determines whether the secondary battery is on the verge of a full charge or the secondary battery has reached
20 a full charge based on the temperature rise, and further determines an estimated time level from among a plurality of different estimated time levels that indicate how much time is required for the secondary battery to reach a full charge based on whether the secondary battery is on the verge of
25 the full charge or the secondary battery has reached the

full charge; and

a display that indicates information regarding the estimated time level based on determination regarding the estimated time level made by the controller,

5 wherein when the controller determines that the secondary battery is on the verge of the full charge, the controller controls the display to indicate an estimated time level indicative of a minimum time required for the secondary battery to reach the full charge.

10 14. A battery charger for charging a secondary battery, comprising:

a battery voltage detector that detects a voltage of the secondary battery and outputs a voltage signal indicative of the voltage of the secondary battery;

15 a controller that calculates a voltage gradient within a predetermined time interval based on the voltage signal, determines whether the secondary battery is on the verge of a full charge or the secondary battery has reached a full charge based on the voltage gradient, and further determines
20 an estimated time level from among a plurality of different estimated time levels that indicate how much time is required for the secondary battery to reach a full charge based on whether the secondary battery is on the verge of the full charge or the secondary battery has reached the
25 full charge; and

a display that indicates information regarding the estimated time level based on determination regarding the estimated time level made by the controller,

5 wherein when the controller determines that the secondary battery is on the verge of the full charge, the controller controls the display to indicate an estimated time level indicative of a minimum time required for the secondary battery to reach the full charge.